

**ENVIRONMENTAL ISSUES REVIEW OF  
USEPA DRAFT PRELIMINARY RISK ASSESSMENT  
ON CREOSOTE**

**for:**

**Creosote Council II**

**by**

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## 1. INTRODUCTION

Creosote is a wood preservative currently undergoing reregistration review by the U. S. Environmental Protection Agency (USEPA) Antimicrobials Division of the Office of Prevention, Pesticides, and Toxic Substances. Preliminary drafts of the creosote risk assessment (RA) were recently provided by the USEPA to the Creosote Council II. The RA includes 11 sections.

Creosote has been used to preserve wood for approximately 100 years. Its efficacy in providing a durable, long-lived, product for use in extreme environments is well demonstrated by the ties that support the U.S. railway system. Over this time, real and potential environmental impacts have been studied extensively. The industrial application of creosote preservative to wood products is now governed by a system of Federal and state regulations. The Environmental Protection Agency (USEPA) has licensed creosote as a pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Scientific studies and other data demonstrate that the continued use of creosote as a wood preservative is consistent with protecting our environment and conserving our resources. Creosote wood preserving plants operating in accordance with current environmental standards and regulations have minimal environmental impacts. Creosote preserved wood products, such as railroad ties and utility poles, are appropriate and environmentally protective when in their intended uses.

This document is a review of the environmental issues of the following selected sections of the RA:

- Use Environmental Fate.
- Profile,
- Environmental Exposure and Modeling, and

## 2. CREOSOTE – USE PROFILE REVIEW

Creosote is a restricted use pesticide. Therefore, only licensed applicators may purchase and apply creosote wood preservative formulations, or direct its use as a wood preservative. . The following creosote application methods are currently used:

- Pressure Treatment. Nearly all creosote wood preservative is applied by Pressure Treatment. With pressure treatment, creosote is applied to wood products in an enclosed pressure vessel utilizing heat, pressure, and vacuum conditions to achieved the required preservative penetration and retention. This only occurs in an industrial facilities.
- Thermal Treatment, also referred to as “Dip Treatment.” Creosote is applied in open top tanks to the portions of wood products in or near ground contact (the butt end) utilizing heat and cool cycles and time to achieve the required preservative penetration and retention at ambient pressures. This process now only used in the Pacific Northwest. It occurs in an industrial facility.
- Pressure and Thermal Treatments account for approximately 99.9 percent of creosote use.
- Field Applications. Creosote is generally applied in the field to previously treated wood structures during construction or as a maintenance procedure. During construction, field cuts that expose untreated wood may be coated with a specialized creosote formulation. Maintenance applications occur related to ground line maintenance of poles or to fill or preserve newly drilled or exposed holes in railroad ties during track maintenance. The amount of creosote used in this way is now insignificant.

In the section, TYPES AND RATES OF APPLICATIONS, the USEPA refers to a number of application methods beyond those noted above. Some of the terminology is not appropriate or is confusing and some of the methods are not currently applicable to current uses of creosote and should be deleted from the Risk Assessment. The following comments address this section.

- All creosote is applied to wood, a forest product. The distinction between “Treatment to Buildings/Finished Wood Products Outdoor,” “Treatment to Forest Products (Seasoned),” “Treatment to Aquatic Structures/Items,” and “Treatment to Forest Products (Seasoned): Not Specified” is confusing and unnecessary. These should be combined to a single category. Additionally, some of these procedures are repeated a second time on Page 5.
- Creosote is not recommended for application to unseasoned wood since the presence of water at more than 20 to 25 percent typical of unseasoned wood will interfere with the effective treatment. Thus, the section titled “Wood Protection Treatment to Forest Products (Unseasoned)” and the associated “Dip Treatment” under this heading should be deleted.

- Formulations of creosote specialized for field application may be applied by trowel or brush or be part of a wrap type product. Spray application is not recommended or appropriate. Spray application methods should be deleted.

### 3. CREOSOTE – ENVIRONMENTAL EXPOSURE AND MODELING REVIEW

The following comments address section III, MODELING.

As noted in the document, the GENEEC model “provides an upper bound estimate” of chemical levels in runoff. Its use as a screening tool only is understood. However, its design and application clearly will result in significant overestimates of constituent levels in runoff. Some of the most significant factors that will result in overestimates include:

- The model is designed for agricultural application of chemical to vegetation and ground surface rather than for a material that is pressure impregnated into solid wood. Thus, much greater availability is assumed.
- The assumptions indicate that either 10% or all of the chemical will leave the cross tie. This ignores the fact that creosote is nearly insoluble in water and only a very small fraction could be leached. Thus, an unrealistically high percentage of creosote is assumed to leave the railroad bed.
- Any PAHs that could leach would tend to bind to soil particles rather than reach a surface water body. (This factor is noted in the Results section of the chapter.) Thus, constituents that would actually remain attached to surface soil are assumed to reach the surface water.
- Additional natural attenuation factors, such as volatilization and biological degradation are assumed to have no effect. In reality, these are also significant.

**Literature Review, Computer Model, and Assessment of the Potential Environmental Risks Associated with Creosote Treated Wood Products Used in Aquatic Environments** (Brooks 1995) is a more appropriate model. It is publicly available from the Western Wood Preservers Institute (WWPI) web page at [www.wwpinstitute.org](http://www.wwpinstitute.org). This model has been developed specifically for creosote treated wood. It represents an environmentally sensitive application; that of pilings installed in a marine environment. And, it has been field verified. This model would be much more appropriate for use by USEPA in modeling releases from creosote treated wood. Creating data in the RA that is known to seriously overestimate actual environmental conditions, even when those levels are low, may be damaging to the industry and is counterproductive to the RA process.

## **4. CREOSOTE – ENVIRONMENTAL FATE REVIEW**

The following subheadings are the same as the subheadings of the Environmental Fate Risk Assessment document to make the comments easier to follow.

### ***1. Executive Summary/Creosote Use Overview***

This section provides an Overview, but does not offer an Executive Summary as implied by its title. A summary of significant conclusions for the environmental fate of creosote should be added. The following paragraph is recommended for the Executive Summary:

Creosote is applied in industrial facilities by pressure or thermal treatment methods. Field application methods are extremely limited and of little relevance. Creosote is effectively studied in the environment as PAHs that comprise the major portion of creosote. Most creosote remains in the treated wood products for the life of the products. PAHs are released from treated wood at rates that decrease geometrically over time with the lighter fractions migrating from the wood more rapidly than the heavier fractions. PAHs are subject to natural degradation factors that remove them from the environment over time. PAHs that do migrate from treated wood are usually degraded and/or immobilized within a zone close to the treated wood structure.

Saying that creosote is an “oil based” preservative may be confusing to readers outside the industry. The term generally is used in contrast to “water borne” preservatives, such as CCA. However, creosote is sold in formulations meeting AWWA specifications that allow no petroleum oil. Thus, it is recommended that USEPA not use the term “oil based” in relation to creosote.

In the second sentence, the word “fractions” should be replaced with “formulations” to be more precise.

The agency’s decision to base the environmental fate assessment on PAHs rather than the whole creosote mixture is sound. Creosote, as such, can not be analytically measured. The only meaningful environmental analyses for creosote are those that measure its primary constituents, which are the PAHs. Even within the category of PAHs, individual PAHs have widely varying characteristics that are critical to evaluating environmental fate, including solubility in water, vapor pressure, and environmental half-life.

Discussion of the environmental fate of PAHs from creosote is misleading without mention of other significant sources of PAHs. There are both natural and human sources of PAHs that greatly exceed the environmental contribution from creosote. These include volcanoes, forest fires, nearly all fossil fuel combustion devices, vehicle exhaust, and oil leaks, seeps, and spills. PAHs have been part of earth’s natural environment from the beginning and life has evolved in the presence of this background of PAHs. It is within this perspective that relatively high levels of PAHs that may pose risks need to be considered.

## **II. Environmental Fate and Chemistry of Creosote**

### **A. Chemical Profile**

The list of common names includes many that are no longer used. The correct common names should be: Creosote, P1/P13 Creosote, and P2 Creosote.

The trade name "Skresote 100" is not valid. Valid trade names include P1/P13 Creosote and P2 Creosote.

Formulations of creosote are derived only from distillates of coal tar. The words "oil based" should be deleted.

### **B. Environmental Fate Assessment**

#### **1. Data Summary**

In the Data Summary section, USEPA reviewed a number of literature references related to creosote. In some cases, additional references are being recommended. **Additional references are named in bold** and more fully cited in the References Section of this document.

#### **Volatility**

**USEPA, AP-42, Fifth Edition, Volume I, Chapter 10: Wood Products Industry, Section 10.8, August 1999 and USEPA, Emission Factor Documentation for AP-42, Section 10.8, Wood Preserving, Final Report, August 1999 (USEPA 1999).** AP-42 is the USEPA's guide to estimating air emissions. The Documentation part of this guide provides methods to estimate the vapor emissions of PAHs from creosote treated wood. The following documents are referenced by the AP-42 documents and are the basis for the method to estimate emissions from the treated wood.

**AquAeTer, Calculated Emissions from Creosote Treated Wood Products (Cross Ties and Poles), October 1994.** This document was based on a several separate studies conducted at wood preserving plants. This author was involved in the process and relates the following supporting explanation based on experience. Two studies were particularly critical in developing the model for estimating emissions from treated wood, as opposed to the emissions from the wood treating process.

First, a study was conducted by Koppers Industries, Inc. at the Feather River Plant, Oroville, California (Feather River Study) in 1990. This study involved placing sets of creosote treated poles of various times since treatment into a plastic enclosure. Air flow was created by a blower that exhausted through a stack. Poles were placed so that 100% of their surface was exposed to the air. The discharged air was monitored and sampled for PAHs and volatile organic constituents.

Second, a study was conducted by AquAeTer at two plants to monitor the rates of cooling of the treated wood following treatment. The results of this study allowed development of emissions formulae that correlated well with the monitoring results of the Feather River Study.



The model, presented in this reference, addressed emissions of naphthalene from the creosote treated wood. The formulae that were developed to estimate naphthalene emissions from treated wood stored at a treating plant could also be used to estimate the continuing rate of evaporation of naphthalene from treated wood in use. For example, the percentages of naphthalene remaining in the wood over time is predicted as follows:

- end of 1 year      96%
- end of 10 years    68%
- end of 20 years    46%
- end of 40 years    21%

A limitation of the Feather River study was that while many of the lower molecular weight PAHs were within the detectable range, non of the high molecular weight carcinogenic PAHs were detected. An approach was developed that proportioned the non-detectable PAHs to naphthalene based on their relative mass fraction in the preservative and single component partial vapor pressures. This data was presented to USEPA and partially reflected in the AP-42 Emission Factor Documentation Report.

The above work has since been further refined by AquaEter to support facility specific air permitting and other emission modeling efforts.

#### **Aerobic/Anaerobic Metabolism**

The data related to the citation of Godsy, E.M., D.F. Goerlitz, and D. Grbic-Galic, 1992, has been misinterpreted. As noted in the review, waste from a wood preserving process was disposed in an unlined surface impoundment that was in direct hydraulic contact with groundwater. The reviewer failed to make the distinction between process waste from wood preserving and treated wood. Process waste would likely have been composed of process wastewater containing high levels of creosote and elevated levels of the lighter fractions that are solvents to the heavier fractions. This represents the worst case scenarios for creosote in the environment and is not at all indicative of the behavior of creosote constituents that might migrate from treated wood. Noting that creosote constituents migrated 150 meters from the pond and up to 6 meters deep from the waste pond is not relevant to creosote treated wood. This misrepresentation is repeated in section B. 2. The discussion should be corrected.

Past practices at wood preserving facilities related to waste disposal are of little relevance to this RA of creosote treated wood. Today, a system of Federal and state regulations for air, water, solid, and hazardous waste carefully controls wood preserving operations and facilities. The various improvements in regulation and practice of wood preserving have been implemented. The practices that caused past contamination have ceased. Objections based on past problems that are no longer occurring are neither relevant nor appropriate to consideration of continued use of creosote wood preservative.

**Literature Review, Computer Model, and Assessment of the Potential Environmental Risks Associated with Creosote Treated Wood Products Used in Aquatic Environments** (Brooks 1995) should be an additional reference. The issues of PAH metabolism in the environment are effectively summarized in the Literature Review.

## **Leaching and Adsorption/Desorption**

**Brooks, 2001, Sooke Basin Creosote Evaluation Study**, evaluated the migration and fate of PAHs from newly installed creosote pilings. Rates of PAH migration were quantified and environmental impacts of those PAHs were evaluated. PAH levels were observed to increase in the immediate vicinity of the pilings, peak, and begin to decrease due to natural degradation processes within the four years of the study.

**Brooks, 2000a, Evaluation of Polycyclic Aromatic Hydrocarbon Migration from Railway Ties into Ballast and Adjacent Wetlands** studied the migration of PAHs from new creosote treated ties in a microcosm test. As a microcosm test, confounding factors of historic releases and other sources were minimized to allow a higher degree of sensitivity. Minimal migration of PAHs was detected from the ties into the ballast rock layer. PAHs that did not degrade within or adhere to the ballast were found to bind to the soil below and at the tow of the ballast. They did not migrate away from the right-of-way. Over time, the rate of degradation matches the rate of release so that no significant accumulation of creosote constituents occurs. In this report, Brooks further states; *"The bottom line is that there is no indication in this study that PAH lost from either the Newly Treated or Weathered Ties presents any potential stress for dragonflies or any other more sensitive species in this wetland."*

Wan, M.T., 1994 appears to present the case of ground-line surface-application of a creosote-chlorophenol mixture and evaluate leaching and/or runoff from the treated poles. There are several significant limitations to the study that affect the relevance to creosote treated wood:

- Railroad rights-of-way are subject to significant confounding sources of PAHs, particularly from oil leaks and drips. Oil, particularly used oil, can contain elevated levels of PAHs and often may affect the rail areas.
- Rail and utility rights-of-way are often parallel to highways with runoff commingled in the ditches. Oil drips and combustion by-products may be significant contributors.
- The formulation used for ground line treatment is no longer used. Thus, the finding below is not now relevant.
- The most significant finding of Wan should be that ditches near utility poles that were treated at ground line with creosote-chlorophenol preservatives had elevated PAH levels while ditches along railroad rights-of-way without utility poles had low levels. In fact, the railroad only ditches had slightly lower PAH levels than the farm ditches. This data is reproduced on page 20 of the Environmental Fate section document.
- Concentrations of PAHs are measured in the runoff, but there is no estimation of the quantity of runoff.

**Assessment of the Environmental Effects Associated with Wooden Bridges Preserved with Creosote, Pentachlorophenol, or Chromated Copper Arsenate** (Brooks, 2000b), evaluates migration of PAHs from creosote treated wood bridges to the nearby environment and the bioaccumulation and biomagnification of PAHs within the environment.

While constituents of creosote were detected and quantified in sediments downstream of the studied bridges, indications were that biological impacts were localized and minimal.

**Weathering Effects on the Decay Resistance of Creosote-Treated Oak.** In a study of decay resistance of creosote treated oak, Chow and Bajwa compared the retention of creosote in newly treated wood samples with the remaining retention of creosote after many years of exposure in the environment. Compared with the new product retention, on average, 67 percent remained after 5 years, 57 percent after 30 years, and 46 percent after 40 years. Clearly, after the initial release of the more mobile constituents, most creosote remains in the wood products for a very long time.

### **Bioaccumulation**

**Literature Review, Computer Model, and Assessment of the Potential Environmental Risks Associated with Creosote Treated Wood Products Used in Aquatic Environments** (Brooks 1995) should be an additional reference. The issues of PAH bioaccumulation and biomagnification in the environment are effectively summarized in the Literature Review.

### **Migration of PAH from Poles to Soils**

**The Electric Power Research Institute (EPRI) study, Pole Preservatives in Soils Adjacent to In-Service Utility Poles in the United States, Report TR-108598, December, 1997**, specifically considers the migration of preservative from poles to the surrounding soils. The interim report summary included the following conclusion:

*PCP concentrations decreased by as much as two orders of magnitude between three and eight inches from the pole, with an overall average attenuation of slightly more than one order of magnitude over this distance. Total PAH concentrations decreased by as much as five orders of magnitude over the same distance, with an overall average attenuation of two orders of magnitude. The data clearly showed that the highest preservative concentrations remained close to the pole.*

## **2. Environmental Fate and Transport**

### **Abiotic Degradation**

The last paragraph of this section claims that "the photooxidized products of PAHs are stable; therefore, may persist in air/water and soils and become an environmental concern as these photooxidized products are also bioaccumulative." Two claims are not substantiated by the cited documents. No basis is provided for stating that the photooxidized products are stable. In fact, the mechanism would likely parallel biological degradation with the products generally being less stable than the parent products. Further, no basis is provided to claim that the products are bioaccumulative. The above quoted statement misleads one toward thinking there is a problem while ignoring the beneficial aspect that PAHs in water and air are degraded by sunlight, contributing significantly to their removal from the environment.

### **Mobility**

At the bottom of page 28 and continuing onto page 29, it is incorrectly concluded that PAHs from utility poles migrated up to 150 meters horizontally and 12 meters deep. These migration distances resulted from placing creosote wood preserving process waste into an unlined surface impoundment. This is not relevant to migration from utility poles. Further, use of surface impoundments for process waste have not been allowed for approximately 20 years. From the literature sources cited, Gile, J.D. et al., 1982, seems much more appropriate related to migration of creosote from treated wood. As stated in the USEPA review of this citation; *"...it was found that 95 percent of the pesticides remained in the wood and most of the materials that leached remained in the upper soil layer immediately surrounding the pine blocks."*

The important conclusion to be made from the reviewed literature and literature sources recommended herein is that PAHs related to creosote treated wood products exhibit very little mobility. The PAHs primarily remain in the wood. The small fractions that do migrate are rapidly isolated through binding to soil or sediment particles or are degraded.

### **Biodegradation**

Several studies are cited that demonstrate that PAHs do degrade in soil and water environments under natural conditions. The fact that degradation occurs is not questioned. The various studies document that the different PAHs degrade at different rates and these rates will vary according to the conditions where they exist. In most situations, rates of biodegradation are sufficient to degrade PAHs that migrate from treated wood structures and, thereby, limit the potential for environmental or human impacts.

### **Bioaccumulation in Fish**

The point is well made that some bioaccumulation of PAHs occurs in fish and other marine species. However, the conclusion that is important related to risk is that biomagnification does not occur or is minimal and that depuration occurs rapidly. In other words, fish living in a contaminated environment will contain some contamination at levels proportional to their exposure. However, the PAH contaminants are not preferentially concentrated in their tissues and after the fish leave the contaminated area they rapidly expel or degrade the contaminants so that they do not remain contaminated.

## 5. CONCLUSIONS

Creosote wood preservative is almost exclusively applied to wood products at industrial pressure or thermal treatment facilities. The risk assessment should focus on these industrial scenarios. Other applications related to the tenth of a percent of use are of little relevance.

The GENEEC model used by USEPA serves no valid purpose for the risk assessment because it grossly overestimates releases. The purpose of the risk assessment would be better served by use of the model designed for treated wood.

There are a number of articles available that offer substantial, valid data related to releases and environmental fate of PAHs from creosote treated wood that were not reviewed, but should have been reviewed, by the USEPA for the Risk Assessment. References for appropriate additional literature documents for USEPA to consider are provided herein.

PAHs will migrate from creosote treated wood, but at very slow rates. Most creosote remains in the treated wood product for the life of the product. Of the small fractions that do migrate, natural attenuation factors mitigate potential environmental and human health impacts. The factors include photooxidation of PAHs that enter surface water or the air, biological degradation of constituents in surface and ground water and soil, and immobilization by adsorption to organic and fine soil particles. While some bioaccumulation of PAHs by aquatic organisms does occur, those organisms natural processes result in rapid excretion and/or degradation of the substances so that the biological processes do not magnify PAHs.

## REFERENCES

Brooks, Kenneth M. 1995. Literature Review, Computer Model, and Assessment of the Potential Environmental Impacts Associated With Creosote Treated Pilings Used in Aquatic Environments, Revised 1997.

USEPA, August 1999. AP-42, Fifth Edition, Volume I, Chapter 10: Wood Products Industry, Section 10.8.

Brooks, Kenneth M., 2000a. Evaluation of Polycyclic Aromatic Hydrocarbon Migration from Railway Ties into Ballast and Adjacent Wetlands.

Brooks, Kenneth M., 2000b. Assessment of the Environmental Effects Associated with Wooden Bridges Preserved with Creosote, Pentachlorophenol, or Chromated Copper Arsenate, USDA Forest Products Laboratory.

EPRI, 1997. Pole Preservatives in Soils Adjacent to In-Service Utility Poles in the United States, Report TR-108598.

Poo Chow and Dilpreet S. Bajwa, Weathering Effects on the Decay Resistance of Creosote-Treated Oak, University of Illinois, Urbana, IL, published in Proceedings of the American Wood Preservers Association, available at [www.rta.org/two\\_tier/research.htm](http://www.rta.org/two_tier/research.htm).